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Is the Saudi Stock Market Efficient? A case of weak-form efficiency

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Abstract
The purpose of the paper is to test the weak-form market efficiency in Saudi Arabia's stock market, Tadawul which is expected to follow a random walk. All share index and sectoral indices for daily closing prices in Tadawul between October 15, 2006 and November 15, 2012 are collected. Unit root Dickey-Fuller test, Pearson Correlation test, Durbin-Watson test and Wald-Wolfowitz runs-test are used as basic stochastic tests for a non-stationarity of the daily prices for all the listed companies in the market, both overall and sector-wise. The four tests confirmed the weak-form market efficiency in the Saudi stock market for All share prices and 11 individual sectors. The findings are necessary for all investors in Saudi Arabia and the member states of the Gulf Cooperation Council (GCC). Listed firms could also benefit from the findings by seeing the true picture of their stock price. The finding is used as a basis for testing the market efficiency in the semi-strong form, which has not yet been tested by any researcher. Accordingly, investors in the Saudi market are not expected to generate abnormal returns simply by depending on past information and technical analysis. This paper will add value to the literature of market efficiency in the emerging market and the GCC since it covers all the listed companies, tests sector-wise, and covers an extended period of time. To confirm the weak-form efficiency in Saudi, the study uses four tests and covers a long period of time during and after the financial crisis.
Keywords: Weak-form market efficiency, random walk hypothesis, unit root test, auto correlation, run test, Kingdom of Saudi Arabia.

1. Introduction

Many studies have tested market efficiency in the developed markets. In the last two decades, studies in the emerging markets started to follow suit. Most of these studies have tried to answer a simple question: Are share prices moving randomly? However, empirical testing came up with mixed findings and different conclusions in both developed and emerging markets. One view in support of the random walk hypothesis (RWH) is that stock returns are following a random walk process and thus, it is not possible to predict their future movements based on past information. The second view, in contrast, states that there is indeed a trend path in the stock returns and that it is possible to predict the future price movements based on the history of prices. The dissimilar results could depend on: (1) the tests that are used; (2) the markets under examination; (3) the type of sector and industry examined, and (4) the time-frame for the study. The RWH which has been tested heavily on the weak-form efficiency has obviously failed to prove the performance of equity markets worldwide. However, developed markets have shown a higher degree of informational efficiency than emerging markets.

The market is said to be efficient when prices of securities reflect all relevant information (Fama, 1991). Investors are freely obtaining new information which makes them, due to competition, immediately discount this information into the price. In other words, there is no chance for an arbitrage opportunity that can be used to make excess abnormal profits (Fama 1965). Efficient market hypothesis (EMH) was earlier developed by Fama (1970) and Fama and French (1989) and later revised to identify three levels of efficiency, which differ in terms of the type of information set reflected in the market. The weak form efficiency, which is the first level of EMH, assumes the absence of predictability of time-series of security prices. This leads to the random walk theory which claims that the prices are independent of each other and past movements or trends cannot be used to predict future movements. Therefore, serial independence (i.e. no autocorrelation) for the set of share price changes is a fundamental requirement for the market to follow a random walk. As Fama (1970) stated that all types of "new" news, by definition, have to be "new and unpredictable", resulting in the unpredictability of future stock prices. Both Samuelson (1965) and Fama (1970) indicated that the EMH supposes that the share price adjusts instantaneously to new information. Hence, current prices should fully discount and reflect all available information and ought to follow a random walk process, meaning that the successive returns are independently and identically distributed. The second level is the semi-strong form efficiency where prices reflect all past prices and the public information. The third level is the strong form efficiency where the share price reflects all past, public and insider information.

EMH deals with the question of whether stock prices fully reflect the entire historical price. The simplest random walk model, as shown in the following equation, states that the actual price equals the previous price plus the realization of a random variable:

$$P_{it} = P_{it-1} + E(R)_{it} + \varepsilon_{it}$$

where:

P_{it} = *Current stock price for firm i*

P_{it-1} = *Last closing price to current time $_{t-1}$*

$E(R)_{it}$ = *Expected return (price change) at time t, also called drift*

ε_{it} = *Random Error*

Furthermore, according to the above equation, the expected return on a security is based on the available information set at time t (φ_t), as argued by (Solnik, 1996): $\boldsymbol{E(R_{it} \mid \varphi_t)}$. The paper investigates informational efficiency in the Saudi stock market for the period January 1, 2007 until October 30, 2012 at the general market and sector levels. Its main purpose is to test the weak-form market efficiency through the random walk model. Accordingly, if the question is answered, it can be decided whether the usage of technical analysis to forecast and predict future price changes is of material benefit. The rationale for this study is that little research has targeted countries from the Middle East and the stock exchanges in the GCC.[1] The knowledge of how efficient a stock market is and how it discounts and reflects the set of information into the market prices of the securities is of central importance to users of the capital markets. Taking into account the economic growth, trade liberalization, introduction of electronic trading, globalization and emergence of global markets; once the behavior of the prices is determined, the easier it is to understand the market and the economy. Another contribution of this study to the literature is the sectoral analysis of the Saudi Arabia, which has been limited to only a few papers.

2. The Saudi Arabia Stock Exchange (TADAWUL)

The Saudi Stock Exchange (Tadawul) is the only stock exchange in the Kingdom of Saudi Arabia. Its trading hours are 11:00AM to 3:30PM, Saturday to Wednesday and it is supervised by the Capital Market Authority (CMA). Saudi joint stock companies had their beginnings in the mid-1930s, when the Arab Automobile was established as the country's first joint stock company. The Saudi Stock Exchange emerged in the late 1970s where the number of joint stock companies was increasing as a result of nationalization of foreign companies, including banks. By 1975 there were about 14 public companies. The rapid economic expansion, beside the nationalization of part of the foreign banks capital in the 1970s led to the establishment of a number of large corporations and joint stock banks. The market remained informal until the early 1980s when the Saudi government created a national stock market. In 1984, a Ministerial Committee composed of the Ministry of Finance and National Economy, Ministry of Commerce and Saudi Arabian Monetary Agency (SAMA) was formed to regulate and develop the market. SAMA was the government body charged with regulating and monitoring market activities until the CMA was established in July 2003 under the Capital Market Law (CML) by Royal Decree No. (M/30). The CMA is the sole regulator and supervisor of the capital market, it issues the required rules and regulations to protect investors and ensure fairness and efficiency in the market. The Council of Ministers approved on March 19, 2007, the formation of the Saudi Stock Exchange (Tadawul) Company. This was in accordance with Article 20 of the Capital Market Law establishing Tadawul as a joint stock company. Tadawul is organized into 15 sectors, each consisting of companies that have a common business line and operate in the same industry. The market capitalization on October 4, 2011 was $315,521 million. In addition, Tadawul All Share Index consists of all listed companies, as shown in table 1.

3. Previous Studies

Bachelier (1900) was the first to point out that security prices and prices of other speculative commodities follow a random walk; this was later confirmed by Pearson (1905) and Working (1934). Kendall (1953) was the first researcher to use the term "random walk" in the finance literature. Until the early 1950s, it was accepted that technical analysis, could be used to examine the behavior of past prices and beat the market. Malkiel (1992) McQueen et al (1996), Fama and French (1989), Al-Loughani and Chappell (1997), Seiler and Rom (1997), and Abrosimova et al (2002) supported the assumption that price changes are random and past prices were not useful in predicting future price.

Alexander (1964) and Fama and Blume (1966) used a filter rule, which gives a rule for buying and selling stocks

[1] The Gulf Cooperation Council countries are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the Uunited Arab Emerats.

depending on past price movements but found that such rule could not generate trading profits. Jensen (1968) performed risk-adjusted measures and found that mutual funds do not outperform the market from 1945–1964. Conrad and Kaul (1988) and Lo and MacKinlay (1988) examined the weekly returns of the NYSE stock and both studies found that a positive serial correlation over short horizons, but one that is negligible and insignificant. Lo and MacKinlay (1988) provide evidence that random walk model was strongly rejected in NYSE-AMEX between 1962 and1985. However, Huber (1995) studied the Vienna Stock Market and rejected the RWH. Kvedaras and Basdevant (2004) concluded that the Estonian, Latvian and Lithuanian Stock Exchange Market, with some turbulence, approaching the weak form of efficiency.

Keim and Stambaugh (1986) found significant predictability in stock prices using forecasts based on certain predetermined variables. Fama and French (1988) show that long holding-period returns are significantly negatively serially correlated, implying that 25-40% of the variation of longer-horizon returns is predictable from past returns. Balaban (1995) rejected the random walk on Istanbul Securities Exchange. Kompa and Matuszewska-Janica (2009) examined the Warsaw Stock Exchange from 2000 to 2006 for the log daily returns. The weak-form efficiency was found in the main market indexes as well as companies in the following sectors: telecommunication, gas and oil, and metals. Medium-size company index was found to achieve abnormal returns.

Reviewing the Arab markets and the GCC, most of the studies used run test and serial correlation to examine the RWH. Gandhi et al (1980) used monthly data for the period 1975-1978 for the Kuwait Stock Exchange and found that RWH for the All Share and Industrial indices was rejected. Testing United Arab Emirates (UAE) market, Ebid (1990) found that it is considered to be weak-form efficient. Butler and Malaikah (1992) analyzed the behavior of the Kuwait and Saudi Arabia stock markets between 1985 and 1989 and they provided evidence of weak-form inefficiency in both of the markets. However, they could not conclude if the Saudi market is informationally inefficient. Civelek (1991) and El-Erian and Kumar (1995) studied the Amman Financial Market and both got relatively frequent positive dependence. Al-Loughani (1995) used the weekly data for the Kuwait Stock Exchange for 1986-1990 and found that autocorrelation and runs test were consistent with the RWH. Khababa (1998) concluded that Saudi market is not weak-form efficient. Dahel and Laabas (1999) examined the behavior of the daily stock prices over the period 1994-1998 in the Gulf markets: Bahrain, Kuwait, Saudi Arabia and Oman. They concluded that Kuwait Stock Market is the only efficient market and is strongly in support of the concepts of the RWH. Abraham et al (2002) used weekly data for All Share indices of Saudi Arabia, Kuwait and Bahrain for 1992-1998. Variance ratio tests rejected the RWH for all three stock markets. By applying the Beveridge and Nelson (1981) decomposition of index returns and after removing the effects of infrequent trading, a RWH was not rejected for the Saudi and Bahraini markets. Taking into considerations market imperfections such as thinly and infrequent trading, Hassan et al (2003) examined Kuwait Stock Exchange over the period 1995-2000 by using EGARCH and GARCH-M and found that the market is weak-form inefficient.

Rao and Shankaraiah (2003) studied the weak form efficiency of the Bahrain Stock Market over the period 1996–2000 and confirmed the weak-form efficiency. Smith (2007) studied the RWH in the Middle Eastern stock markets and found that Israeli, Jordanian, and Lebanese markets were weak-form efficient while the Kuwait and Oman markets were not. For the Tel-Aviv, Amman and Beirut stock market and non-Kuwaiti companies that traded on the Kuwait stock market, stock price indices follow a random walk. Moustafa (2004) examined the behavior of the prices in the UAE stock market and concluded that most firms are weak-form efficient and prices follow a random walk. Babaker (2004) investigated the market efficiency of all Arab Stock Exchanges and the results showed that emerging markets are less efficient than developed markets. In addition, at different time periods, stock markets vary in efficiency. Asiri (2000, 2004, 2007) examined Kuwait's stock market for the daily stock prices for 1999-2001, 1991-2002 and 2000-2002. Using unit root test, ARIMA (AR1); exponential smoothing and autocorrelation tests confirmed the weak-form efficiency. Sector analysis also gives robust support to the findings. The results confirmed the randomness for all share prices and each sector. Studying all companies listed on the Bahrain Stock Exchange, Asiri (2008) confirmed that all daily prices and each sector follow a random walk with no drift and trend and supporting the weak-form market efficiency. Using daily sectoral indices between 2000 and 2005, Squalli (2006) explored the efficiency in the different sectors of the Dubai Financial Market (DFM) and Abu Dhabi Securities Market (ADSM). Variance ratio tests rejected the randomness in all of the sectors in UAE except in the banking sector in DFM. In comparison, using runs test, the insurance sector of the ADSM gave evidence of weak-form efficiency in the UAE. Al-Khazali et al (2007) re-examined the empirical validity of the weak-form in emerging markets of the MENA region: Bahrain, Egypt, Jordan, Kuwait, Morocco, Oman, Saudi Arabia and Tunisia. In their study, they utilized the Lo and MacKinlay (1988, 1989), Wright's (2000) rank and sign VR and the runs tests. Once the returns from the indices were adjusted to reconcile distortions from thinly and infrequently traded stocks, the study found random walk and weak-form efficiency in all of the markets examined.

Using multiple variance tests on different sectors, Benjelloun and Squalli (2008) tested the markets of Jordan, Qatar, Saudi Arabia and the UAE and found that there is no consistency in their results among the different sectors and the different markets. Randomness was rejected in Jordan, Abu Dhabi and Dubai when using the general index. However, if the sectoral indexes were used, they failed to reject the randomness in some sectors. Using the runs test, randomness was rejected in all of the stock market if general indexes were used, with the exception to Dubai. However, using the sectoral indexes, they have failed to reject the weak-form efficiency in some sectors.

Elango and Hussein (2008) examined the market efficiency across seven stock markets in the GCC countries[2] for the daily indices over the period 2001-2006. Kolmogorov-Smirnov test shows that all of the seven markets reject the RWH and using the runs test for randomness, they found that the successive price changes were not random. Marashdeh and Shrestha (2008) investigated if the stock price index in the UAE follows random by using unit root, Augmented Dickey Fuller and Philip-Perron tests along with Perron's Innovational Outliner and Additive Outliner models. The results show that the data has a unit root and follows a random walk. Awad and Daraghma (2009) examined the efficiency of the Palestine Security Exchange for 35 stocks listed in the market using the daily indices and concluded that daily returns are inefficient in the weak-form. AlKhazali (2011) has conducted a study examining the market efficiency in the Gulf countries and concluded that the RWH is not rejected in all the GCC markets. Al-Jafari (2011) and Al-Jafari and Altaee (2011) found that both Bahrain and Kuwait stock markets are informationally inefficient at the weak-form level. Salameh et al (2011) explored the weak form market efficiency for Saudi Arabia, Amman, Kuwait, Dubai, Abu Dhabi, Egypt, Morocco, Tunisia, Qatar, Oman, Bahrain and Palestine markets. In general, Saudi Market was the only market that behaved randomly under both the serial autocorrelation tests and the runs test. However, under both the Augmented Dickey-Fuller and Phillips-Perron unit root tests, it was found that all of the markets do not behave randomly. Testing the daily closing prices for the eleven high-volume trading banks listed on the Karachi Stock Exchange, Bashir et al (2011-a) rejected the weak-form efficiency in the banking sector and (2011-b) rejected in the textile sector in Pakistan.

4. Data and Methodology

The Data. All Share Index and sectoral indices for daily closing prices in Tadawul over the period October 30, 2006 through November 15, 2012 are collected. The data set consists of the daily closing values of 16 indices, the All-Share Index (TASI), and 15 other sectoral indices. The data collected is for two periods: during and after the financial crisis. Random walk is tested for the whole market and then for each sector and each period. The actual returns on the market are calculated as follows:

$$R_{it} = [(I_{it} - I_{it-1}) / I_{it-1}] \times 100$$

where:

R_{it} = *the daily return on day t for sector i*

I_{it} = *stock index closing value for sector i*

I_{it-1} = *stock index closing value for sector i on day t-1*

The daily return is computed either as a percentage or logarithmic price change. Osborne (1959) suggested that the lognormal probability distribution of price change is better explained in random walk. Jaradat and Al-Zeaud (2011) justified this measure by arguing that mathematically, logarithm of relative price is producing a time series of continuously compounded returns. Using the same approach of Srinivasan (2010), stock market returns are defined as continuously compounded or log returns at time t. Furthermore, as per Lauterbach and Ungar (1995), continuously compounded returns are additive and their distribution follows the normal distribution more closely than arithmetic returns. Therefore, stock returns are calculated by the log difference change in the price index.

Dickey-Fuller Unit Root Test with Drift. Most researchers used the unit root test in order to test for the non-stationary which is the necessary condition for the presence of random walk. Equation (1) presents the simple form of unit root, where current price is expected to be totally explained by lagged price by one period (slope coefficient = 1). If this is not true, then the current price is explained by a constant (drift) which is α, and a coefficient for the lagged price to be less than 1. The null hypothesis in this case is: Ho: $\beta=1$ against Ha: $\beta<1$.

$$\mathbf{P_{it} = \alpha + \beta P_{it-1} + \varepsilon_{it}} \qquad \textbf{(1)}$$

where:

[2] Each GCC country has one market and the UAE has two markets: the Abu Dhabi Secruities Market and Dubai Financial Market.

α = *Expected price change or drift*
β = *Expected to be unity*
P_{it} = *Current daily share price for firm i*
P_{it-1} = *Lagged one period current daily share price for firm i*
ε_{it} = *Independently and identically distributed with mean 0 and constant variance σ^2, IID (0, σ^2).*

The independence in the error (ε_{it}) implies that increments are uncorrelated and that any non-linear function of the increments is also uncorrelated. In addition, the model is assuming that increments are identically distributed and the error term (ε) is assumed to be white noise.

Formulating the above equation in the first difference, as considered by Dickey and Fuller, P_{it-1} is subtracted from both sides and the model is:

$$\Delta P_{it} = \alpha + \rho P_{it-1} + \varepsilon_{it} \quad (2)$$

where:
ΔP_{it} = *First difference in share price for firm i*
α = *Expected price change or drift*
ρ = *(Slope – 1)*
P_{it-1} = *Lagged one period current daily share price for firm i*

Since the actual price is changed to the first difference, the hypothesis testing would change to Ho: $\rho = 0$ against Ha: $\rho < 0$. Model (1) is testing for a coefficient of 1, while model 2 is testing for a coefficient of 0. The more negative the ρ, the better the t-value would be to reject the null hypothesis and conclude that prices are stationary and do not follow random walks.

Pearson Product-Moment Correlation Coefficient. Applying the same method used by Kendall (1953), the correlation coefficient between the current return on an index and the one period lag-return should indicate if there is a serial correlation. A positive coefficient indicates a tendency towards a possible continuation momentum of abnormal returns on the next day, while a negative sign is a tendency towards a possible reversal of returns. If the sign is significant, then that is a hint of possible market inefficiencies, and today's returns can be used to predict future expected returns. However, if serial correlation coefficients are small, there is no 'systematic' correlation but rather a 'negligible' relation between one price change and the subsequent ones, and would be consistent with the weak-form efficiency.

Autocorrelation test via the Durbin-Watson (D-W) Statistic. Gupta (2010) argued that Durbin-Watson test is the best test to detect autocorrelation as such:

$$d = \frac{\sum_{t=2}^{n}(e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^2} \quad (3)$$

where:
d = *Durbin-Watson Statistics*
e_t = *the residuals from a regression for time period t*
e_{t-1} = *the residuals from a regression fro time period t-1*

To test for positive autocorrelation at significance α, the test statistic d is compared to lower and upper critical values (d_L and d_U):

If $d < d_L$ = error terms are positively autocorrelated
If $d > d_U$ = error terms are not positively autocorrelated
If $d_L < d < d_U$ = the test is inconclusive

Statistically, the absence of statistical significance in autocorrelation test implies that the series follow a random walk, which means that the market is efficient at the weak-form. The assumption of normally distributed random errors is needed to derive the probability distribution of the test statistic used in the D-W test. This method has also been used extensively by: Kendall (1953), Fama (1965), Fama and French (1989), Worthington and Higgs (2006), Squalli (2006), Sharma and Mahendru (2009), Rao and Shankaraiah (2003), Awad and Daraghma (2009), and Omran and Farrar (2006).

Wald-Wolfowitz Runs Test. Fama (1965) argued that this test examines the serial dependence in share price movements. If no influence exists, then it can be said that the observations are independent. The runs test is a nonparametric test, which can be used to test for independence between successive series without requiring normality of the distribution. After observing the number of 'runs' in a sequence of price changes, randomness is tested at 5% significance level with an absolute Z value greater than 1.96 and 1% significance level with an absolute Z value greater than 2.58 indicating non-randomness.

$$\boldsymbol{Z} = \frac{\boldsymbol{R-M}}{\boldsymbol{\sigma}} \quad \textbf{(4)}$$

where:

Z = *standard normal variable*

R = *number of runs*

M = $1 + \frac{(2\text{nu} \times \text{nd})}{(\text{nu} + \text{nd})}$ = mean number of runs

σ = $\left[\frac{(2\text{nu x nd})(2\text{nu x nd} - \text{nu} - \text{nd})}{(\text{nu} + \text{nd})^2 \text{x} (\text{nu} + \text{nd} - 1)}\right]^{\frac{1}{2}}$ = *standard deviation*

nu, nd = *number of ups and down in observations in each category*

5. The Findings

Table 2 presents a summary of the descriptive statistics of the daily returns for All Share indices and sectors, measured in log. Figure 1 clearly shows the simple pattern of randomness in All Share prices. Figure 2 highlights the normality of the returns for All Share index which is one of the conditions for the unit root test.

The Dickey-Fuller (DF) Test. Table 3 summarizes the main statistics derived from running the OLS for the current closing index for All Share as a function of the lagged one period index. At the 1% level of significance, the most important statistic, which is the t-value on β, is providing evidence that the slope β is insignificantly different from 1 (t-value -2 < -2.862). T-test for the intercept (α = 0, i.e. no drift) indicates that the t-value is insignificant to reject the null hypothesis. In other words, the model is a random walk without drift. Therefore, it is concluded that prices in the KSA Stock Exchange are following a random walk. The best prediction of the current price is the last price. R^2 indicates that 99.30% of the variation in the current price is explained by the lagged share price. Figure 3 supports the above findings, and it clearly shows that the current share price (index) could not generate any excess return in the next period, with the exception of few unusual observation.

Changing the dependent variable to the "first difference of the closing price" (ΔP_t) as a function of lagged closing price and the white noise, is providing an alternative test to stationarity. The hypothesis to be tested is Ho: β = 0 against the alternative Ha: β < 0. Table 3 presents the summary results for the unit root tests (actual closing price and first difference in price) which provide evidence that share prices in Tadawul are following random walk. The coefficient for lagged price is close to zero (β=-0.003) and t-value (-1.609) suggests that there is not enough evidence to reject the null hypothesis that the slope coefficient is not significantly different from zero. If this is the case, then the series exhibits a unit root and is non-stationary. D-W of 2.054 rejects the problem of autocorrelation in the model. Testing individual indices for the 15 sectors, it is found that only Banks and Financial Services do not follow random walk (t-value = -4.67).

Pearson Correlation Coefficient. It is found that out of 16 indices in Tadawul tested (All Share Index and 15 sectoral indices), none of them showed any strong or even moderate relationship between the daily returns and the lagged return with correlation of coefficient varying between 0.203 for the Energy and Utilities and 0.028 for the Media and Publishing sector. Thus, the current daily prices change of the indices is independent from the previous day's change. Table 4 summarizes the coefficients for all sectors which are found to be very weak.

Autocorrelation test (D-W Statistic). No positive autocorrelation is found in the All Share Indexes or their sectoral indices. All of the *d*-statistics are very close to 2, which lead to the conclusion that there is no positive autocorrelation in the Saudi Market, and hence the market is weak-form efficient. From the 16 indices tested, we could not find a positive serial correlation between the residuals in any index, and thus all of the indices tested have met the criteria of an efficient market hypothesis at the weak-form (Table 4).

Runs-Test. From this test, it is found that at 5% level of significance, the All Share "TASI" returns from the market index follow random walk, and from the 15 sectors, 11 exhibited daily returns that followed random walks. The four that do not follow random walk are Banks and Financial Services (Z= -2.442), Energy and Utilities (Z= 2.414), Insurance (Z= -2.855), and Building and Construction (Z= -2.733). Testing at 1% level of significance, only two sectors are not following random walks: Insurance and Building and Constructions. These results are shown in table 4.

Comparing the results of the four tests on each sector, we find some contradictory results, and thus we have controversial findings and cannot reach to a final conclusion whether the daily returns of these indices are informationally efficient in the weak-form. In general, sector-wise, the market of Saudi Arabia's Tadawul is found to be closer to the properties of the weak-form efficiency of EMH. Accordingly, it is not expected that there will be investors in the market of Saudi Arabia whom can generate excessive returns by simply depending on past information and technical analysis to formulate trading decision beating the market on a continuous and

systematical basis. In addition, All Share Index has met the properties of the weak-form efficiency in all the models tested along with 11 out of the 15 sectors. Table 4 summarizes the findings of the four tests used for the different indices in the Saudi Arabia.
Testing the random walk for share prices during and post financial crisis confirmed the main findings for All Share index in most of the tests conducted (see Table 5). Furthermore, figure 4 compares the random walks during these two periods.

6. Conclusion

The purpose of this study is to explore and test the random walk and weak-form informational market efficiency in the Saudi Arabia. In order to examine the behavior of the daily returns of the stock markets, both overall and sector-wise, four tests are applied: Dicky-Fuller unit root, Pearson correlation coefficient, Durbin-Watson (autocorrelation), and Wald-Wolfowitz runs-tests. The findings show empirical evidence that Saudi stock prices exhibit unit root for the All Share index and for the individual sectors with the exception of Banking and Financial Services sector. In addition, All Share indices showed no significant correlation between the daily returns, and the remaining indices did not show any strong or even moderate relationship between the daily returns. Using the Durbin-Watson statistic, none of the indices exhibit a positive autocorrelation during the period of the study. However, using the runs-test for testing randomness, at 5% level of significance, only four indices out of the total 16 indices, did not qualify to behave similar to a RWM. While at 1% level of significance, only two sectors did not follow random walk. As a result, a final conclusion cannot be reached whether or not the daily returns of these indices follow a random walk and are informationally efficient in the weak-form for the whole market. However, by using four tests, most of the results provide evidence to conclude that in general, sector-wise, the market of Saudi Arabia's Tadawul is weak-form efficient. Moreover, with confidence, we can say that the All Share general market index of Saudi Arabia and 11 indices have met the properties of the weak-form efficiency of EMH using all of the models tested.
Consequently, it is not expected that there will be investors in the market of Saudi Arabia who can generate excessive returns by simply depending on past information and technical analysis to formulate trading decision beating the market on a continuous and systematical basis. The findings of this study are considered to be an added value to the literature concerning the random walk and testing the weak-form market efficiency in the emerging markets, especially in the MENA region and GCC countries. These results can be a starting point for further studies testing the semi-strong form of EMH in Saudi Arabia.

References

Abraham, A., Seyyed, F. J. and Alsakran, S. A. (2002), "Testing the Random Walk Behavior and Efficiency of the Gulf Stock Markets", *The Financial Review*, Vol. 37, No. (3), pp. 469-480.
Abrosimova, N., Dissanaike, G. and Linowski, D. (2002), *"Testing Weak-Form Efficiency of the Russian Stock Market"*, Working Paper Presented at the EFA Berlin Meetings, 20 February.
Alexander, S. S. (1964), "Price Movements in Speculative Markets: Trends or Random Walk, Number 2", *Industrial Management Review*, Vol. V (Spring), pp. 25-46.
Al-Jafari, M. K. (2011). "Random Walks and Market Efficiency Tests: Evidence from Emerging Equity Market of Kuwait", *European Journal of Economics, Finance and Administrative Sciences*, Vol. 36, pp. 19-28.
Al-Jafari, M. K. and Altaee, H. H. A. (2011), "Testing the Random Walk Behavior and Efficiency of the Egyptian Equity Market", *Journal of Money, Investment and Banking*, Issue 22, pp. 132-146.
AlKhazali, O. (2011), "Does Infrequent Trading Make a Difference on Stock Market Efficiency? Evidence from the Gulf Cooperation Council (GCC) Countries", *Studies in Economics and Finance*, Vol. 28, No. 2, 2011, pp. 96-110.
Al-Khazali, O. M., Ding, D. K., and Pyun, C. S. (2007), "A New Variance Ratio Test of Random Walk in Emerging Markets: A Revisit", *The Financial Review*, Vol. 42, pp. 303-317.
Al-Loughani, N. E. (1995), "Random Walk in Thinly Traded Stock Market: The Case of Kuwait", *Arab Journal of Administrative Science*, Vol. 3, Issue No. 1, pp. 189-209.
_____, and Chappell, D. (1997). On the validity of the weak form efficient market hypothesis applied to the London Stock Exchange, *Applied Financial Economics*, Vol. 7, 173-176.
Asiri, B. K. (2000), *"Random walk in the Kuwaiti security prices"*, paper presented at the Portuguese Finance Network – First Finance Conference, 28 June-1 July.
_____ (2004), *"Test of market efficiency – a case of Kuwait stock market"*, paper presented at the Gulf Stock Exchange Role on the Support and Activation of the Economic Development Potentials in the GCC Countries Conference, Muscat, Oman, 2-3 October

_____ (2007), “Measuring the Efficiency of Kuwait Stock Market”, *Arab Journal of Administrative Sciences*, Vol. 14, No. 2, pp. 265-280.

_____ (2008), “Testing Weak-Form Efficiency in the Bahrain Stock Market”, *International Journal of Emerging Markets*, Vol. 3, (No. 1), pp. 38-53.

Awad, I., and Daraghma, Z. (2009), “Testing the Weak-Form Efficiency of the Palestinian Securities Market”, *International Research Journal of Finance and Economics*, Issue 32, pp. 7-17.

Babaker, M. (2004), *“Some Empirical Investigations about the Efficiency of Arab Stock Markets”*, paper presented at the Gulf Stock Exchange Role on the Support and Activation of the economic Development Potentials in the GCC Countries Conference, Muscat, Oman.

Bachelier, L. (1900), “Theorie de la Speculation, Gauthier-Villars, Paris, 1900”, A Thesis submitted to the Faculty of the Academy of Paris on March 29, 1900 and Reprinted in English (A. J. Boness, trans.) *“Theory of Speculation”*.

Balaban, E. (1995), *“Informational Efficiency of the Istanbul Securities Exchange and Some Rationale for Public Regulation”*, The Central Bank of the Republic of Turkey Research Department, Discussion Paper No. 9502, February.

Bashir, T., Ilyas, M., and Furrukh, A. (2011-a), “Testing the Weak-Form Efficiency of Pakistani Stock Markets – An Empirical Study in Banking Sector”, *European Journal of Economics, Finance and Administrative Sciences*, Issue 31, pp. 160-175.

_____, Ahmad, M., Ilyas, M. and Malik, M. U. (2011-b), “Weak-Form Efficiency of Textile Sector: An Empirical Evidence from Pakistan”, *Interdisciplinary Journal of Contemporary Research in Business*, Vol. 2, No. 12, pp. 600-617.

Benjelloun, H. & Squalli, J. (2008), “Do General Indexes Mask Sectoral Efficiency? A Multiple Variance Ratio Assessment of Middle Eastern Equity Markets”, *International Journal of Managerial Finance*, Vol. 4, No. (2), pp. 136-151.

Beveridge, S. and Nelson, C. R. (1981), “A New Approach to Decomposition of Economic Time Series into Permanent and Transitory Components with Particular Attention to Measurement of the Business Cycle”, *Journal of Monetary Economics*, Vol. 7, pp. 151-174.

Butler, K. C., and Malaikah, S. J. (1992), “Efficiency and Inefficiency in Thinly Traded Stock Markets: Kuwait and Saudi Arabia”, *Journal of Banking & Finance*, Vol. 16, Issue No. 1, pp. 197-210.

Civelek, M. A. (1991), “Stock Market Efficiency Revisited: Evidence from the Amman Stock Exchange”, *The Middle East Business & Economic Review*, Vol. 3, pp. 27-31.

Conrad, J. and Kaul, G. (1988), “Time-Variation in Expected Returns”, *Journal of Business*, Vol. 61 (October 1988), pp. 409-425.

Dahel, R. and Laabas, B. (1999), “The Behavior of Stock Prices in the GCC Markets”, *Journal of Development & Economic Policies*, Vol. 1, pp. 89-105.

Ebid, S. (1990), “Characteristics and Behavior of UAE Stock Market”, *Journal of Economic and Administrative Sciences*, Vol. 6, pp. 19-61.

Elango, R. and Hussein, M. I. (2008), “An Empirical Analysis on the Weak-Form Efficiency of the GCC Markets Applying Selected Statistical Tests”, *International Review of Business Research Papers*, Vol. 4, No. 1, pp. 140-159.

El-Erian, M. A. and Kumar, M. S. (1995), “Emerging Equity Markets in Middle Eastern Countries in development of financial makets in the Arab countries, Iran and Turkey.”, *IMF Staff Papers*, IMF, Vol. 42, No. 2, pp. 313-343.

Fama, E. F. (1965), “The Behavior of Stock-Market Prices”, *Journal of Business*, Vol. 38, No. 1, (January).

_____ (1970), “Efficient Capital Markets: A Review of Theory and Empirical Work”, *The Journal of Finance*, Vol. 25, No. (2), pp. 383-417.

_____ (1991), “Efficient Capital Markets: II”, *The Journal of Finance*, Vol. 46, No. 5, pp. 1575-1617.

_____ and Blume, M. (1966), “Filter Rules and Stock Market Trading Profits”, *Journal of Business* ,Vol. 39, Issue 1, (Part 2: Supplement on Security Prices, January 1966), pp. 226-241.

_____ and French, K. R. (1988), “Permanent and Temporary Components of Stock Prices”, *Journal of Political Economy*, Vol. 96 No. 2, pp. 246-273.

_____ and _____ (1989), “Business Conditions and Expected Returns on Stocks and Bonds”, *Journal of Financial Economics*, Vol. 25, Issue (1), pp. 23-49.

Gandhi, D., Saunders, A. and Woodward, R. (1980), “Thin Capital Markets: A Case Study of the Kuwaiti Stock Market”, *Applied Economics*, Vol. 12, pp. 341-349.

Gupta, A. (2010), "A Critical Analysis of Weak Form Efficiency in Indian Stock Market", *Asian Journal of Management Research*, Vol. 1, No. 2, pp. 657-665.

Hassan, K. M., Al-Sultan, W. S. and Al-Saleem, J. A. (2003), "Stock Market Efficiency in the Gulf Cooperation Council Countries (GCC): The Case of Kuwait Stock Exchange", *Scientific Journal of Administrative Development*, Vol. 1, No. 1, I.A.D. 2003, pp. 1-21.

Huber, P. (1995), *"Random walks in Stock Exchanges Prices and the Vienna Stock Exchange"*, Working Paper, Economic Series, No. 2, 1-25.

Jaradat, M. A. and Al-Zeaud, H. A. (2011), "Testing the Weak-Form Efficiency of Amman Stock Exchange", *International Research Journal of Finance and Economics*, Issue 65, pp. 93-97.

Jensen, M. C. (1968), "The Performance of Mutual Funds in the Period 1945-1964", *The Journal of Finance*, Vol. 23, No. 2, Issue No. 2, pp. 389-416.

Keim, D. and Stambaugh, R. (1986), "Predicting returns in stock and bon markets", *Journal of Financial Economics*, Vol. 17, pp. 357-90.

Kendall, M. G. (1953), "The Analysis of Economic Time-Series-Part I: Prices", *Journal of the Royal Statistical Society 96, Series A (General)*, Vol. 116, Issue No.1, pp. 11–25.

Khababa, N. (1998), "Behavior of Stock Prices in the Saudi Arabian Financial Market: Empirical Research Findings", *Journal of Financial Management & Analysis*, Vol. 11 (1) Jan-June, pp. 48-55.

Kompa, K. and Matuszewska-Janica, A. (2009), "Efficiency of the Warsaw Stock Exchange: Analysis of Selected Properties", *International advances in Economic Research*, Vol. 15 (1), pp. 59-70.

Kvedaras, V. and Basdevant, O. (2004), "Testing the Efficiency of Emerging Capital Markets: The Case of the Baltic States", *Journal of Probability and Statistical Science*, Vol. 2 No. 1, pp. 111-138.

Lauterbach, B. and Ungar, M. (1995), "Real vs. Nominal Stock Return Seasonalities: Empirical Evidence" *International Review of Economics and Finance*, Vol. 4, Issue No. (2), pp. 133-147.

Lo, A.W. and MacKinlay, A. C. (1988), "Stock Market Prices Do Not Follow Random Walks: Evidence from a Simple Specification Test", *The Review of Financial Studies*, Vol. 1, No. (1), (Spring 1988), pp. 41-66.

_____ and _____ (1989), "The size and power of variance ratio test in finite samples: a Monte Carlo investigation", *Journal of Econometrics*, Vol. 40, pp. 203-38.

Malkiel, B. G. (1992), "Efficient Market Hypothesis", in Newman, P., Milgate, M. and Eatwell J. (eds.), *"New Palgrave Dictionary of Money and Finance"*, Macmillan, London.

Marashdeh, H. and Shrestha, M. B. (2008), "Efficiency in Emerging Markets- Evidence from the Emirates Securities Market", *European Journal of Economics, Finance and Administrative Sciences*, Issue 12, pp.143-150.

McQueen, G., Pinegar, M. and Thorley, S. (1996), "Delayed reaction to good news and the cross-autocorrelation of portfolio returns", *Journal of Finance*, Vol. 51 No. 3, pp. 889-920.

Moustafa, M. A. (2004), "Testing the Weak-Form Efficiency of the United Arab Emirates Stock market",

Omran, M. and Farrar, S. (2006), "Tests of Weak Form Efficiency in the Middle East Emerging Markets", *Studies in Economics and Finance*, Vol. 23, No.1, pp. 13-26.

Osborne, M. F. (1959), "Brownian Motion in the Stock Market", *Operations Research*, Vol. 7, No. 2, pp.145-173.

Pearson, K. (1905), "The Problem of the Random Walk", *Nature*, Vol. 72, No. 1867, pp. 294; 318; 342.

Rao, D.N. and Shankaraiah, K. (2003), "Stock Market Efficiency and Strategies for Developing GCC Financial Markets: A Case Study of the Bahrain Stock Market", *The Arab Bank Review*, Vol. 5 (No. 2), pp. 16-21.

Salameh, H. M., Twairesh, A. E., Al-Jafari, M. K. and Altaee, H. H. A. (2011), "Are Arab Stock Exchanges Efficient at the Weak-Form Level? Evidence from Twelve Arab Stock Markets", *European Journal of Economics, Finance and Administrative Sciences*, Issue 39, pp. 18-31.

Samuelson, P.A. (1965), "Proof That Properly Anticipated Prices Fluctuate Randomly", *Industrial Management Review*, Vol. 6, No. 2, pp. 41-49.

Seiler, M.J. and Rom, W. (1997), "A historical analysis of market efficiency: Do historical returns follow a random walk?", *Journal of Financial and Strategic Decisions*, Vol. 10 No. 2, pp. 49-57.

Sharma, G. D. and Mahendru, M. (2009), "Efficiency Hypothesis of the Stock Markets: A Case of Indian Securities", *International Journal of Business and Management*, Vol. 4, No.3, March 2009, pp.136-144.

Smith, G. (2007), "Random Walks in Middle Eastern Stock Markets", *Applied Financial Economics*, Vol. 17, pp. 587-596.

Squalli, J. (2006), "A Non-Parametric Assessment of Weak-Form Efficiency in the UAE Financial Markets", *Applied Financial Economics*, Vol. 16, Issue No. 18, pp. 1365-1373.

Srinivasan, P. (2010), "Testing Weak-Form Efficiency of Indian Stock Markets", *Asia Pacific Journal of Research in Business Management*, Vol. 1, Issue 2, pp. 134-140.

Worthington, A. C., and Higgs, H. (2006), "Evaluating Financial Development in Emerging Capital Markets with Efficiency Benchmarks", *Journal of Economic Development*, Vol. 31, Issue 1, pp. 17-44.
Working, H. (1934), "A Random-Difference Series for the Use in the Analysis of Time series", *Journal of the American Statistics Association*, Vol. 29, (March), pp. 11-24.
Wright, J. (2000), "Alternative Variance-Ratio Tests Using Ranks and Signs", *Journal of Business and Economics Statistics*, Vol. 18, pp. 1-9.

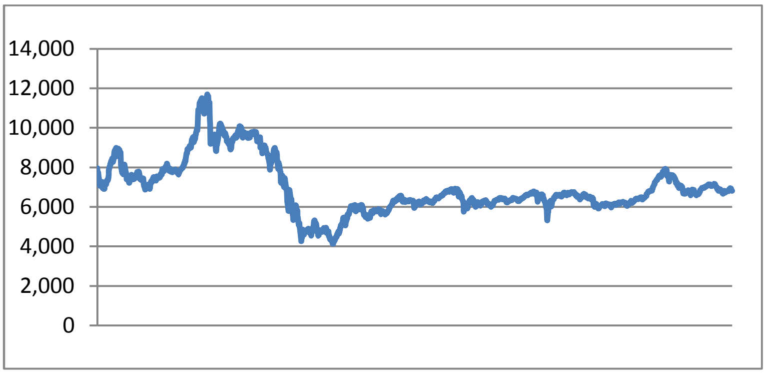

Figure 1: Closing Indices for Tadawul All-Share "TASI"

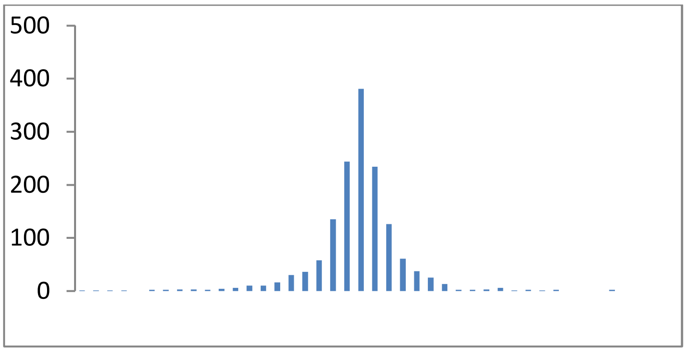

Figure 2: Distribution of returns for Tadawul All-Share Index "TASI"

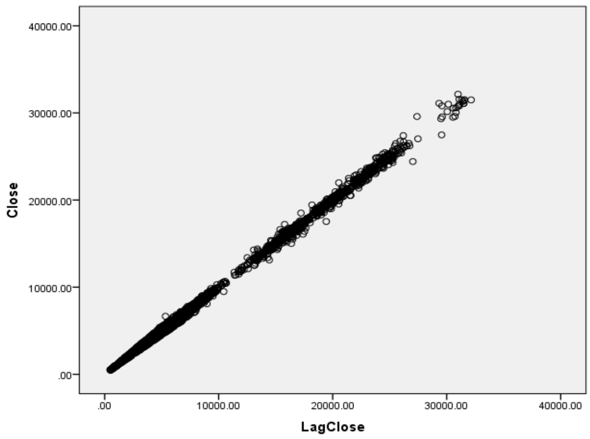

Figure 3: Closing prices against Lag prices for All-Share "TASI"

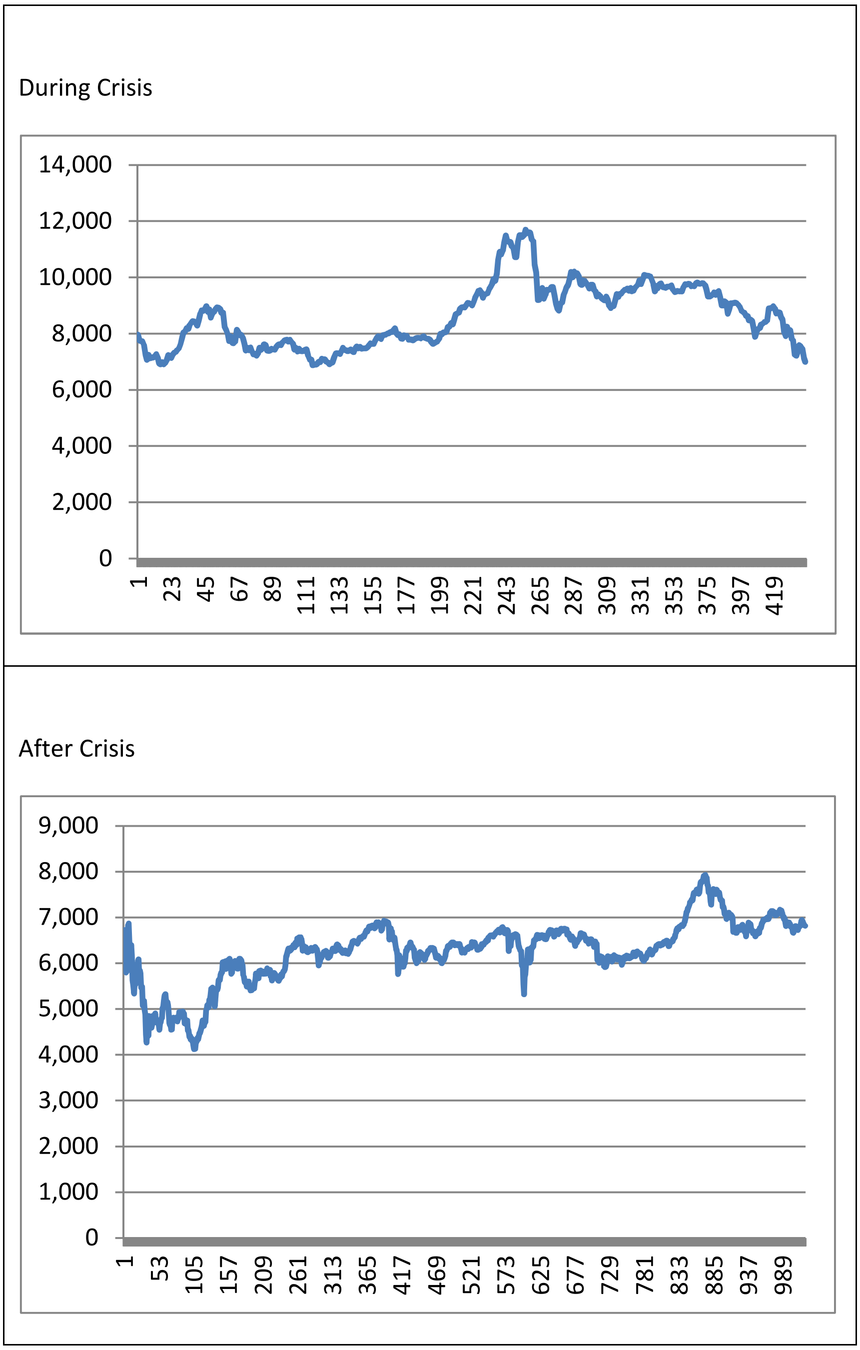

Figure 4: Financial crisis and random walk in TASI

Table 1: Tadawul Market Structure

Sector code	Sector Name	No. of companies in the index
TASI	**Tadawul All Share Index**	**150**
TBFSI	Banks & Financial Services Sector	11
TPISI	Petrochemical Industries Sector	14
TCESI	Cement Sector	10
TRESI	Retail Sector	10
TEUSI	Energy & Utilities Sector	2
TAFSI	Agriculture & Food Industries Sector	15
TTISI	Telecom & Information Technology Sector	5
TINSI	Insurance Sector	31
TMISI	Multi-Investment Sector	7
TIVSI	Industrial Investment Sector	13
TBCSI	Building & Construction Sector	15
TRDSI	Real Estate Development Sector	8
TTRSI	Transport Sector	4
TMPSI	Media and Publishing Sector	3
THTSI	Hotel & Tourism Sector	2

Table 2: Summary Statistics for Tadawul

Daily Returns	Min	Max	Mean	Std. Dev.	Skewness	Kurtosis
All Share TASI	-.0998	.2489	-.000106	.0206400	-.247	6.500
TAFSI	-.0963	.0953	.000130	.0188385	-.429	5.968
TBCSI	-.0991	.0987	-.000226	.0221368	-.607	4.861
TBFSI	-.0978	.0913	-.000244	.0175964	.014	6.197
TCESI	-.0986	.0975	-.000043	.0152281	-.249	10.400
TEUSI	-.0982	.0956	.000089	.0181705	.178	6.154
THTSI	-.0993	.2489	.000302	.0261277	.587	9.668
TINSI	-.0956	.0974	-.000131	.0226482	-.541	3.177
TIVSI	-.0981	.0979	.000250	.0213593	-.646	4.556
TMISI	-.0979	.1207	-.000475	.0230984	-.487	4.935
TMPSI	-.0996	.1003	-.000646	.0216263	-.150	4.851
TPISI	-.0992	.0989	.000441	.0233343	-.476	4.405
TRDSI	-.0995	.0990	-.000492	.0189798	-.326	6.253
TRESI	-.0987	.0991	.000214	.0181629	-.457	7.432
TTISI	-.0998	.0990	-.000368	.0174865	-.285	6.988
TTRSI	-.0991	.0977	-.000392	.0221046	-.146	5.149

Table 3: Summary results for the unit root test

Sectors	Index	Dependent Variable: Price Expected β = 1					Dependent Variable: change in price[3] Expected β = 0	
		Slope: β	Drift: α	Se β	T (DF)	R^2	Slope: β	Drift: α
All-Share	TASI	0.996	23.65	.002	-2	0.993	-.003	23.267
1	TBFSI	0.986*	279*	.003	**-4.67**	0.977	-.004	66.525
2	TPISI	0.997	147.9	.002	-1.5	0.969	-.003	21.613
3	TCESI	0.997	12.94	.002	-1.5	0.996	-.002	10.833
4	TRESI	0.991	43.87**	.004	-2.25	0.980	-.009**	42.980**
5	TEUSI	0.989	50.63*	.004	-2.75	0.980	-.010**	46.556**
6	TAFSI	0.989	54.82*	.004	-2.75	0.978	-.011**	53.020**
7	TTISI	0.995	46.91*	.002	-2.5	0.982	-.005**	9.286
8	TINSI	0.998	2.01	.002	-1	0.996	-.002	1.653
9	TMISI	0.998	21.66***	.002	-1	0.990	-.002	4.888
10	TIVSI	0.992	96.47*	.004	-2	0.973	-.008**	40.800**
11	TBCSI	0.998	7.61	.002	-1	0.995	-.002	7.616
12	TRDSI	0.998	13.56	.002	-1	0.992	-.002	6.189
13	TTRSI	0.995	32.69**	.003	-1.67	0.983	-.005	15.354
14	TMPSI	0.995	10.48	.002	-2.5	0.991	-.004**	7.689
15	THTSI	0.986	159*	.005	-2.2	0.959	-.014**	75.222*

* significant at 1%   ** significant at 5%   *** significant at 10%

[3] Since returns on index is calculated as "change in index", using first difference or returns as a variable provided similar results.

Table 4: Summary results for the four tests
Sample size = 23,488 observations

Sectors	Index	DF Unit Root Ho: Unit root		Correlation Ho: No correlation		Durbin-Watson Ho: No autocorrelation		Runs-Test Ho: Random Series	
		B	Unit root	Value	Random Walk	*d* statistics	Random Walk	Z statistic	Random Walk
All-Share	TASI	0.996	Don't Reject	0.084	Don't Reject	2.008	Don't Reject	-1.438	Don't Reject
1	TBFSI	**0.986**	**Reject**	0.109	Don't Reject	2.003	Don't Reject	**-2.442**	**Reject**
2	TPISI	0.997	Don't Reject	0.046	Don't Reject	2.006	Don't Reject	-0.698	Don't Reject
3	TCESI	0.997	Don't Reject	0.060	Don't Reject	2.003	Don't Reject	-0.638	Don't Reject
4	TRESI	0.991	Don't Reject	0.034	Don't Reject	1.998	Don't Reject	0.582	Don't Reject
5	TEUSI	0.989	Don't Reject	0.203	Don't Reject	2.003	Don't Reject	**2.414**	**Reject**
6	TAFSI	0.989	Don't Reject	0.081	Don't Reject	2.003	Don't Reject	-1.511	Don't Reject
7	TTISI	0.995	Don't Reject	0.061	Don't Reject	2.003	Don't Reject	-1.341	Don't Reject
8	TINSI	0.998	Don't Reject	0.114	Don't Reject	2.008	Don't Reject	**-2.855**	**Reject**
9	TMISI	0.998	Don't Reject	0.094	Don't Reject	1.998	Don't Reject	1.014	Don't Reject
10	TIVSI	0.992	Don't Reject	0.035	Don't Reject	2.005	Don't Reject	0.930	Don't Reject
11	TBCSI	0.998	Don't Reject	0.130	Don't Reject	2.008	Don't Reject	**-2.733**	**Reject**
12	TRDSI	0.998	Don't Reject	0.067	Don't Reject	2.003	Don't Reject	0.582	Don't Reject
13	TTRSI	0.995	Don't Reject	0.043	Don't Reject	1.996	Don't Reject	0.584	Don't Reject
14	TMPSI	0.995	Don't Reject	0.028	Don't Reject	1.998	Don't Reject	1.221	Don't Reject
15	THTSI	0.986	Don't Reject	0.037	Don't Reject	2.002	Don't Reject	0.001	Don't Reject

Table 5: Financial crisis and the randomness of share prices for TASI

States	df	DF Unit Root Ho: Unit root		Correlation Ho: No correlation		Durbin-Watson Ho: No autocorrelation		Runs-Test Ho: Random Series	
		B	Unit root	Value	Random Walk	*d* statistics	Random Walk	Z statistic	Random Walk
During-crisis	439	0.992	Don’t Reject	0.146	Don’t Reject	1.977	Don’t Reject	-2.339	Don’t Reject*
Post crisis	1023	0.990	Don’t Reject	0.053	Don’t Reject	1.903	Don’t Reject	-0.469	Don’t Reject

* at 1% level of significance